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# First record of the family Stenasellidae (Crustacea, Isopoda) in Iran with the description of a new cave-dwelling species

Yaser Bakhshi[1], Saber Sadeghi[1], Giuseppe Messana[2]

**1** *Department of Biology, Shiraz University, Shiraz, Iran* **2** *Institute for the Study of Ecosystems, UOS Firenze, Italy*

Corresponding author: *Saber Sadeghi* (ssadeghi@shirazu.ac.ir)

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## Abstract

A new cave isopod species of the genus *Stenasellus* Dollfus, 1897 (Stenasellidae) from Iran is reported and described. The new species, *Stenasellus tashanensis* **sp. n.** was found in Tashan Cave (Khuzestan province, southwest Iran). A complete description and drawings of the new species are provided. This new species is morphologically close to *S. vermeuleni* Magniez & Stock, 2000 from Oman.

## Keywords

Isopods, *Stenasellus*, Stygobiont, Cavernicolous

## Introduction

With approximately 1.65 million km$^2$, Iran is a vast country in the Western Palearctic. Iran hosts a high variety of habitats including more than 2000 caves, mostly located in the Zagros Range (Raeisi et al. 2012). This mountain chain is rich in caves and has been the object of numerous speleological explorations dating back to the 1970's (Juberthie et al. 2001).

In the last two decades, several studies have been conducted regarding the fauna of Iranian caves (e.g. Karaman 1998; Casale and Quéinnec 2001; Sadeghi et al. 2014;

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Esmaeili-Rineh et al. 2015, 2017; Malek Hosseini et al. 2016). Nonetheless, the subterranean fauna of Iran is still poorly known. Several species of oligochaetes, crustaceans (Copepoda, Isopoda, Amphipoda), hydracarids, insects, fish and amphibians, have been collected and described from Iranian caves (Juberthie et al. 2001; Esmaeili-Rineh et al. 2017; Moradmand 2017).

The family Stenasellidae, with more than 70 described species, is limited to subterranean aquatic habitats including karstic or phreatic springs (Wilson 2008). The first specimens of this family were discovered in the subterranean waters from SW France (Viré 1896). Later, Dollfus (1897) examined the specimens and described them as *Stenasellus virei* Dollfus, 1897. The genus *Stenasellus* Dollfus, 1897 has a wide distribution in the Old World from the Far East (Borneo, Cambodia, Sumatra, Thailand) to Central Asia (Turkmenistan), Arabian Peninsula (Oman, Socotra), East Africa (Kenya and Somalia), and southern Europe (Iberian Peninsula, southern France, Corsica and Sardinia) (cf. Magniez and Stock 2000).

In 1999, in a paper dealing with four new *Stenasellus* species from Oman, Magniez and Stock predicted the presence of Stenasellid isopods in Iran: "...we might ask if they (Stenasellidae) are present in intermediate geographical regions. Yemen, southwestern Oman and southern Iran could harbour this fauna...". In fact, by describing *Stenasellus tashanensis* sp. n. from Iran in the present study, their prediction has been confirmed and the antiquity and wide Tethyan distribution of the genus *Stenasellus* as stated by Magniez (2005, 2008), have been ratified. We collected some Stygobiont isopods from Tashan Cave (Figure 1), in southwest of Iran during a field trip on January 1, 2016, which on closer examination appeared to belong to a new species of the genus *Stenasellus*.

## Material and methods

All the specimens (two males and three females) were collected using a small hand net in Tashan cave, located 12 km north of Behbahan city in Khuzestan Province (southwest Iran). Tashan cave is located on the western side of the Zagros Mountains (Figure 1) in Neozoic limestone. Tashan Cave is about 150 m long, with two stagnant water pools which are connected to each other by small channels. The depth of the first pool, where the specimens were found, was about 1 m in the deepest part. The second pool was deeper, about 4–5 m in the deepest part. No specimen was found in the second one. The bottom of both pools is represented by greyish-white fine sediments. The pools water had the following physico-chemical characteristics: TDS = 350 mg/l, Salinity = 0.35%, Conductivity = 717 µS/cm, pH = 7.8, Temperature = 25.6 °C.

The collected specimens were preserved in ethanol 96%. One male and one female were dissected and microscopic slides of their body parts were prepared using Euparal mounting medium. To study the specimens, a stereomicroscope (Zeiss Stemi SV 11 Apo) and a compound microscope (Olympus BX 50) were used. For the chaetotaxy, Watling (1989) was followed.

The type specimens of *Stenasellus* species described from East Africa deposited at Zoological Museum of University of Firenze, Italy (MZF) were compared with our specimens by the third author, but since the authors did not have access to all the type material of the congeneric species, to compare them with the species in the present study, data (including descriptions and illustrations) from the literature (Birstein and Starostin 1949; Magniez and Stock 2000) were also used for this procedure.

## Results

**Order Isopoda Latreille, 1817**
**Suborder Asellota Latreille, 1802**
**Family Stenasellidae Dudich, 1924**
**Genus *Stenasellus* Dollfus, 1897**

***Stenasellus tashanensis* Bakhshi & Messana, sp. n.**
http://zoobank.org/049C8EB6-2F82-4459-9200-9FCB206D4895

**Holotype.** ***Male.*** 19 mm, Tashan Cave, Behbahan, Khuzestan, Iran 30°51'57.00"N, 50°10'30.09"E. 16.I.2016 leg. Y. Bakhshi (ZM-CBSU Iso 3421); Paratypes 1 male 19 mm (on three slides), 3 females (1 specimen (18, 15 mm) on two slides) same data as that of holotype (ZM-CBSU Iso 3422), maximum observed length of females is 18,15 mm, maximum observed length of males is 19 mm. The type specimens were deposited at the Zoological Museum of Shiraz University, Collection of the Biology Department (ZM-CBSU).

**Diagnosis.** *Stenasellus tashanensis* can be differentiated from all of the other congeneric species by the following characteristics: the shape of male peleopods I and II, 19 strong spines on dactyl and 19 strong dentate spines on propus of male peraeopod I, three sternal spines on dactylus of peraeopod 7, and seven toothed coupling hooks on endite the maxilliped which is the largest number found in any *Stenasellus* species.

**Description** (complementary to iconography) (Figure 2A). A relatively large *Stenasellus* with subparallel margins, maximum observed length (in males) 19 mm, maximum observed width (fourth segment) 3.8 mm. Head wider than long, with concave anterior margin, two typical round spots (otoliths of Bellonci's organs) on anterior lateral angles. Endopodites of pleopods III–V bifid. Uropods/pleotelson length ratio 0.625.

Antenna I (Figure 2B): short, less than half the length of antenna II, not reaching posterior margin of first pereonite; second article of peduncle with three plumose setae on its distal part; flagellum with up to 19 articles, with two aestetascs on distal external angle of each of the last 12 segments.

Antenna II (Figure 2C): long, reaching pereonite V; peduncle with six segments; squama on third article of peduncle (Figure 2C') sub-rounded, equipped with two pointed long setae of different sizes, flagellum with up to 55 articles.

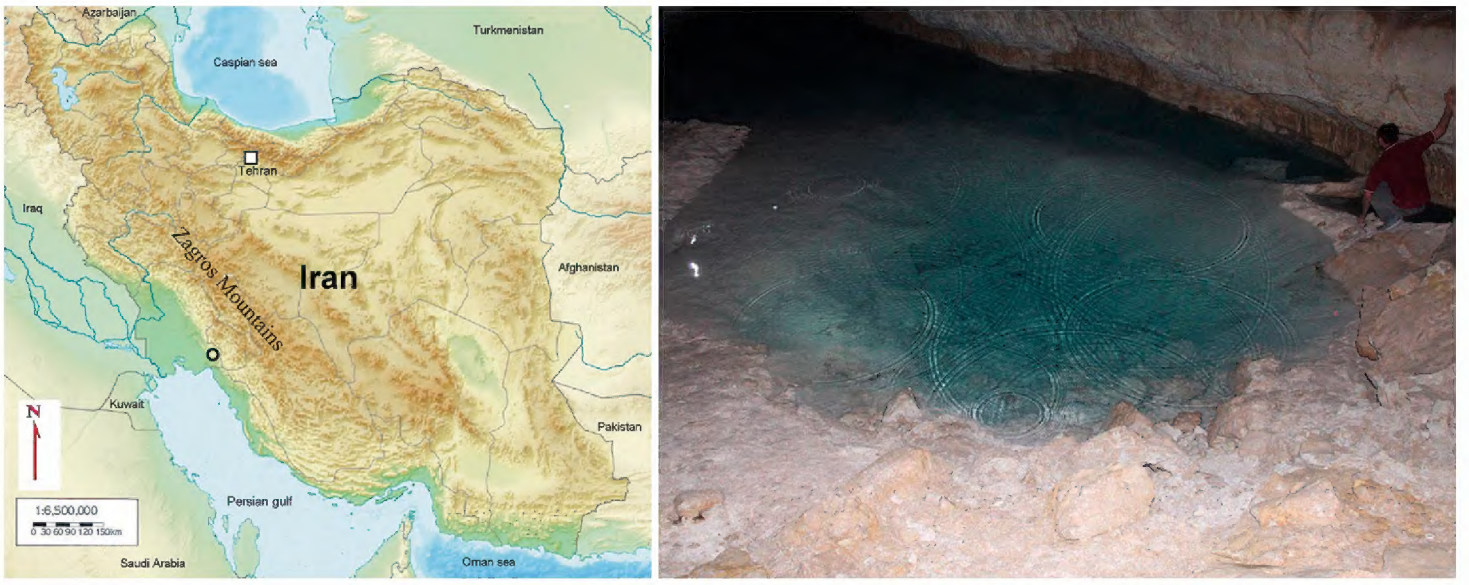


**Figure 1.** Left: Map of Iran, showing the location of Tashan Cave (black circle); Right: the type locality in Tashan Cave, with *Stenasellus tashanensis* sp. n.

Left mandible (Figure 2H): pars incisiva four-dentate; lacinia mobilis four-dentate; 18–20 lifting spines (12 spinulate); pars molaris with several setae.

Right mandible (Figure 2G): pars incisiva four-dentate; 29–30 lifting spines (19 spinulate); pars molaris with several setae.

Mandibular palp (Figure 2I): tri-articulate; first article with two setae on distal margin, one of them five times longer than the other, second article with several setae including a group of soft short ones and another group of combed long ones, third article with several spines of different sizes, the five distal ones significantly longer than the others.

First maxilla (Figure 2E): exite with 12 dentate combed setae and 8 plumose ones, endite with 3 strong and 2 thinner setose setae.

Second maxilla (Figure 2F): external exite with 10 and median exite with 11 falcate, combed setae; internal exite with 25 denticulate chaetae.

Maxilliped (Figure 2D): with 6 to 7-toothed coupling hooks on endite and 13 plumose setae on distal margin, 18 glabrous setae on the outer surface; palp five-segmented, first article with a single simple seta on the distal inner angle.

Peraeopod I (Figure 3A): strong, subchaelate; with 19 strong setae on dactyl and 19 strong denticulate setae and several simple setae of different sizes on propus.

Peraeopods II–VII (Figure 3B–G): progressively larger; basis with 9 to 12 long plumose setae; propus and carpus with plumose seta on distal tergal angles; Peraeopods 2–4 also with pectinate seta in same position; dactylus with strong medial spines, three in peraeopod 7 and two in peraeopods 2–6.

Genital papilla (Figure 4H): subcylindrical, passing anterior margin of second pleonite.

Male Pleopod I (Figure 4A): basipodite with one coupling hook; Exopodite with about 33 setae, the eighteen internal of which plumose.

Female pleopod II (Figure 4F): subtriangular; with a strongly convex outer margin, five setae on the sternal surface and ten plumose setae on the distal margin.

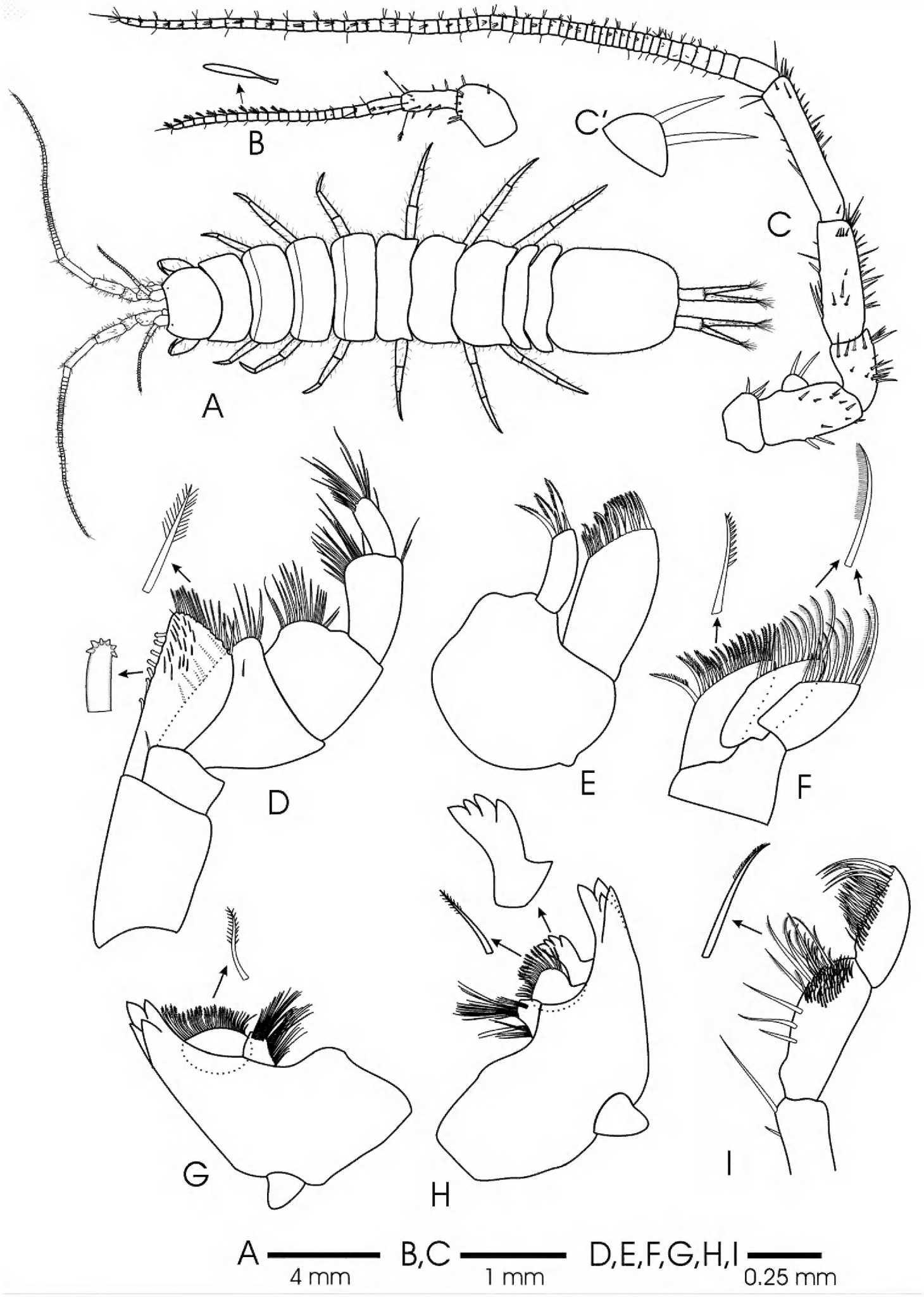


**Figure 2.** *Stenasellus tashanensis* sp. n. male. **A** habitus (dorsal view) **B** antenna I **C** antenna II **C'** squama of antenna II **D** maxilliped **E** maxilla I **F** maxilla II **G** right mandible **H** left mandible **I** mandibular palp.

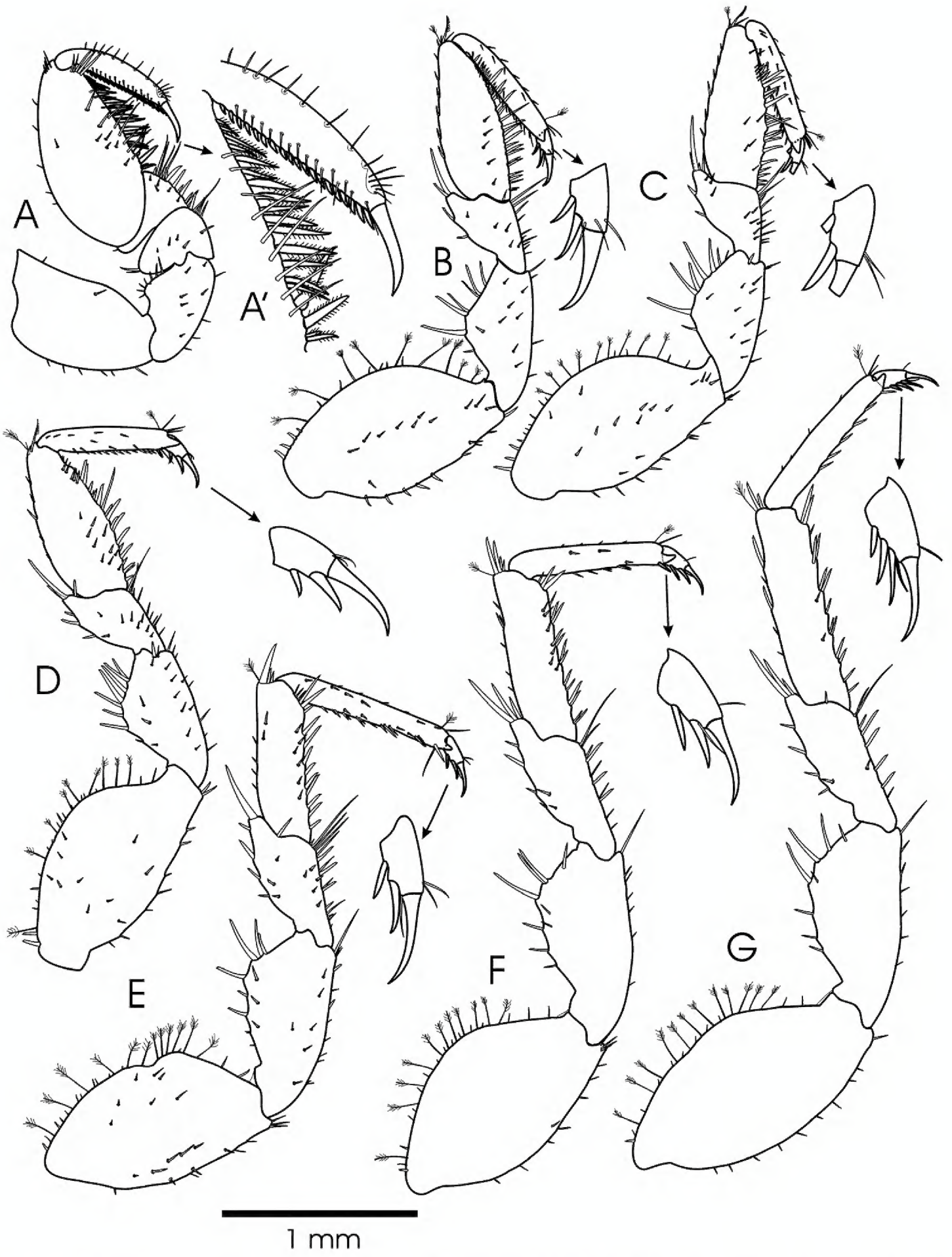


**Figure 3.** *Stenasellus tashanensis* sp. n. male. **A–G** peraeopods I–VII **A'** setation of propus and dactylus of first peraeopod.

Male pleopod II (Figure 4B): sympodite sub-rectangular; significantly longer than wide with subparallel external and internal margins, sternal surface with three paramedial setae; proximal article of exopodite with four glabrous setae, distal article subelliptical relatively elongated (longer than wide) with more than 40 plumose setae along the

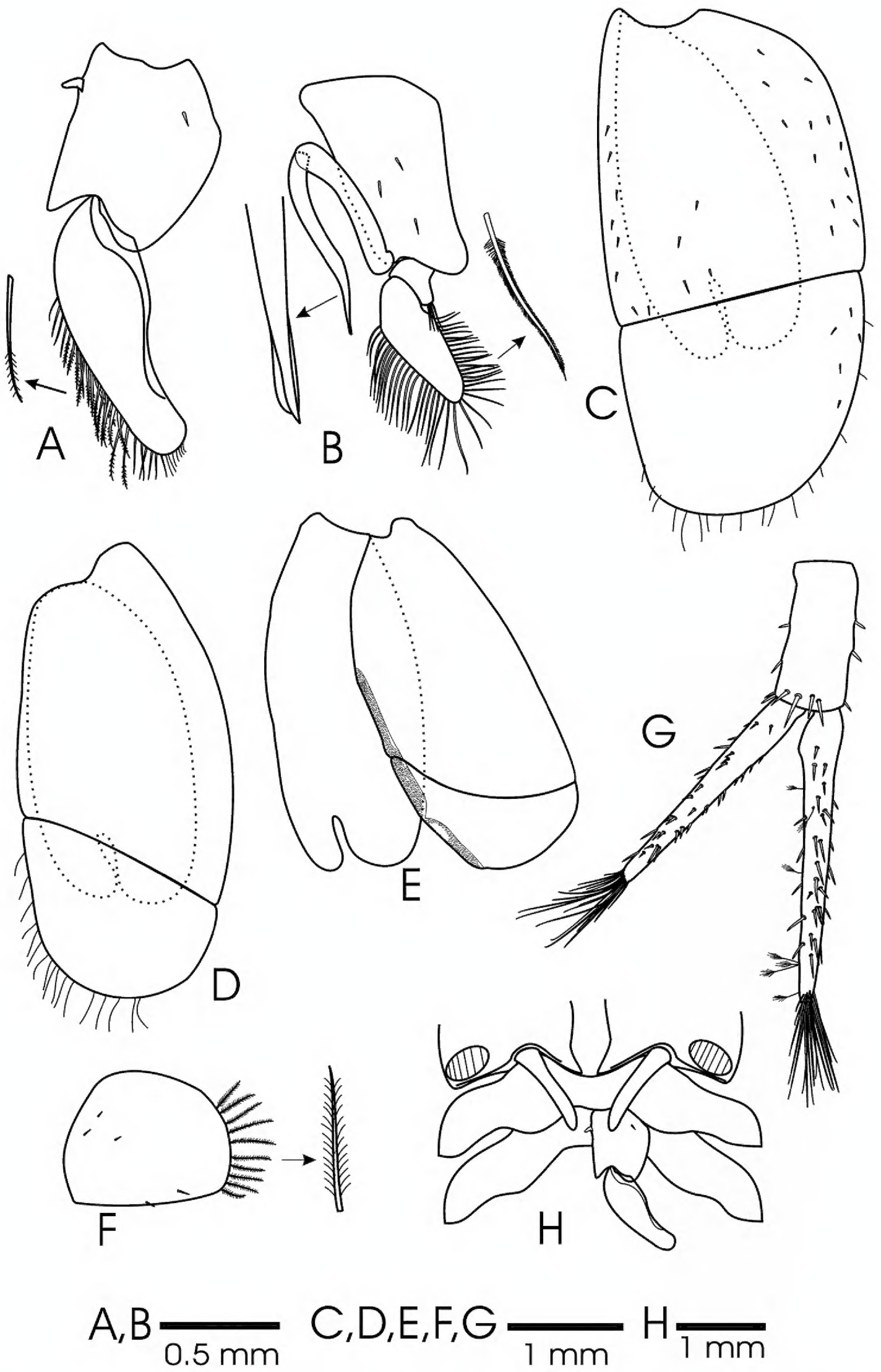


**Figure 4.** *Stenasellus tashanensis* sp. n. **A–E** pleopods I–V of male **F** pleopod II of female **G** uropod **H** genital papillae on seventh sternite.

margin; distal article of endopodite as long as proximal article and with accommodating groove, gutter-like in its caudal part.

Pleopods III–V (Figure 4C–E): exopodite with transverse oblique suture, submedial in the third and subterminal in the fourth and fifth pleopods; endopodite bilobate in all three pleopods.

Uropods (Figure 4G): exopodite slightly smaller than endopodite which bears seven plumose setae on proximal, medial, and distal parts.

**Etymology.** Topotypic, referring to the type locality, Tashan Cave.

## Discussion

Several species of the genus *Stenasellus* were recorded in countries adjacent to Iran: *S. asiaticus* Birstein & Starostin, 1949 was recorded from Turkmenistan while four species including *S. vermeuleni* Magniez & Stock, 2000, *S. messanai* Magniez & Stock, 2000, *S. henryi* Magniez & Stock, 2000, and *S. grafi* Magniez & Stock, 2000 were recorded from Oman. One species was also described from Socotra Island (Messana pers. comm.) and seven species are present in East Africa) (Messana 1990, 2001).

Hence, as Magniez and Stock (1999) stated "This possibility concerns particularly southern Iran. We must not forget that, as late as 18,000 BP, the Persian Gulf was reduced, offering a continuity of groundwater between the Oman and Iranian aquifers", the presence of *Stenasellus tashanensis* n. sp. in Iran, strengthens the paleogeographic reconstructions dealing with this genus present in the karst and groundwater environments from the Far East to East Africa and Europe. Magniez and Stock (1999) showed a strict morphological similarity among the Far East, the Middle East, and the East African species, a result that may also be true for this new Iranian species.

*S. tashanensis* can be recognized from other *Stenasellus* species described from countries adjacent to Iran, by the significant differences including body size and the morphology of body appendages (Figures 5–7).

Maximum body length in *S. tashanensis* is 19 mm (vs up to 11 mm in *S. vermeuleni*, up to 8 mm in *S. messanai*, 3–4.5 mm in *S. henryi*, less than 2.5 mm in *S. grafi* and about 11.5 mm is *S. asiaticus*). The main morphological differences between *S. tashanensis* and other congeners from countries adjacent to Iran, are shown in Figures 5–7.

The general morphology of the *S. tashanensis* resembles that of *S. vermeuleni*, although there are significant differences in general and detailed characteristics such as the length of both antennae I and II, the number of strong spines on dactyls of the first peraeopod and the shape of the first and second male pleopods. The new species can be recognized from *S. vermeuleni* by the detailed following characteristics: In *S. tashanensis* the exopodite of male pleopod I is flatter than in *S. vermeuleni*, where the exopodite is strongly twisted on its longitudinal axis (Figure 5); in male pleopod II, sympodite is subrectangular with almost parallel margins (vs sub-pentagonal with convex external margin and concave internal margin in *S. vermeuleni*), proximal article of exopodite bears 4 setae (vs 2–3 in *S. vermeuleni*), distal article is sub-elliptical and bears 40–42 setae (vs subtriangular with 30–35 setae in *S. vermeuleni*), the length of proximal article of endopodite is

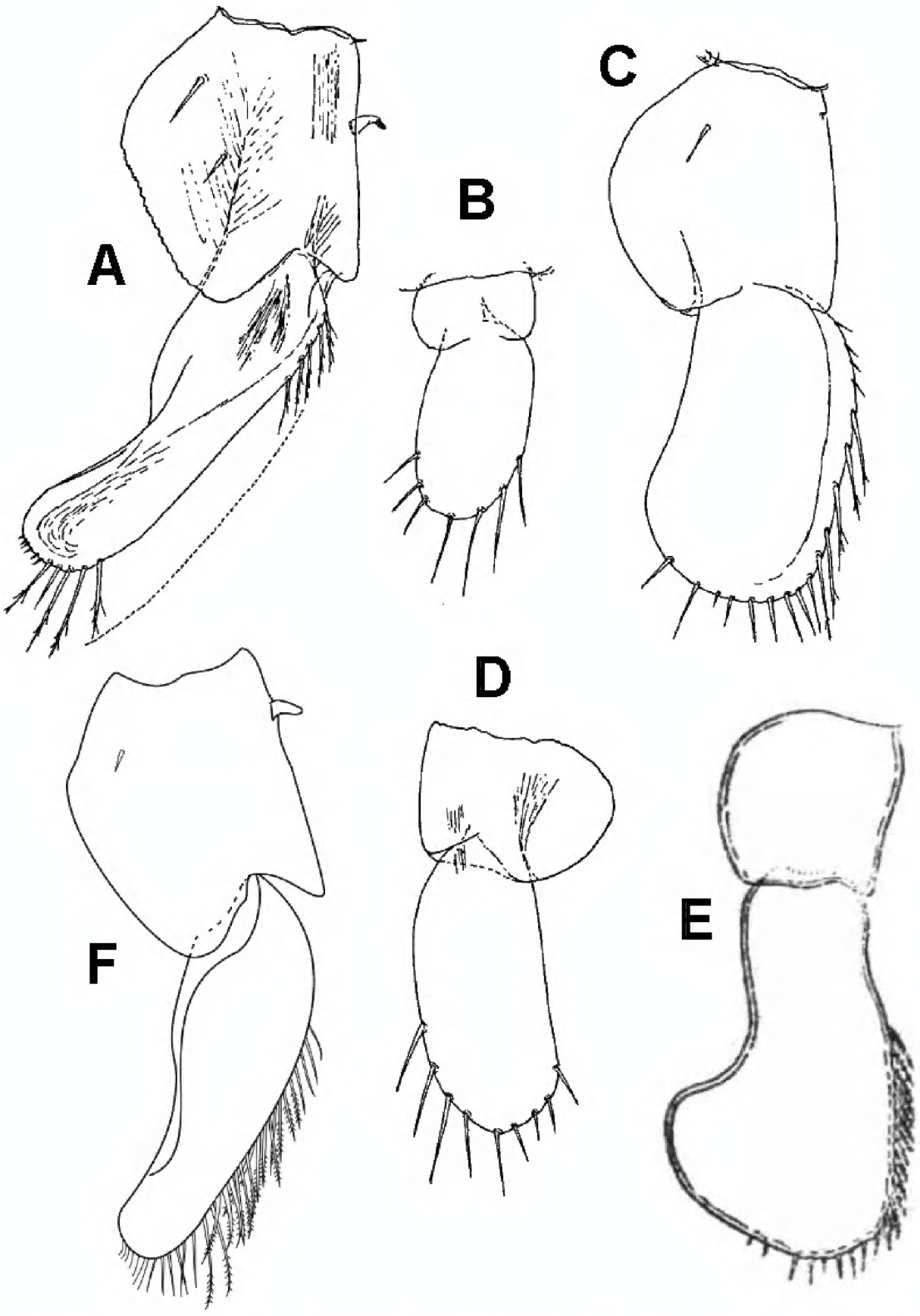


**Figure 5.** Male pleopod I of *Stenasellus vermeuleni* (**A**) *S. grafi* (**B**) *S. messanai* (**C**) *S. henryi* (**D**) *S. asiaticus* (**E**) and *S. tashanensis* sp. n. (**F**). (Figures **A–D** from Magniez and Stock 2000; Figure **E** from Birstein and Starostin 1949).

ca. 0.75 length of sympodite (vs almost as long as sympodite in *S. vermeuleni*), the length of distal article of endopodite is ca. 0.9 length of sympodite (vs 1.29 times longer than sympodite in *S. vermeuleni*); The second pleopod of female is sub-circular (vs subtriangular in *S. vermeuleni*) (Figure 6); Squama of antenna II bears two strong setae (vs 3 in *S. vermeuleni* ) (Figure 7). The chaetotaxy of the mandibular lobe is strongly different in the mandibles of the two species. In *S. tashanensis* left mandible has 18–20 lifting spines

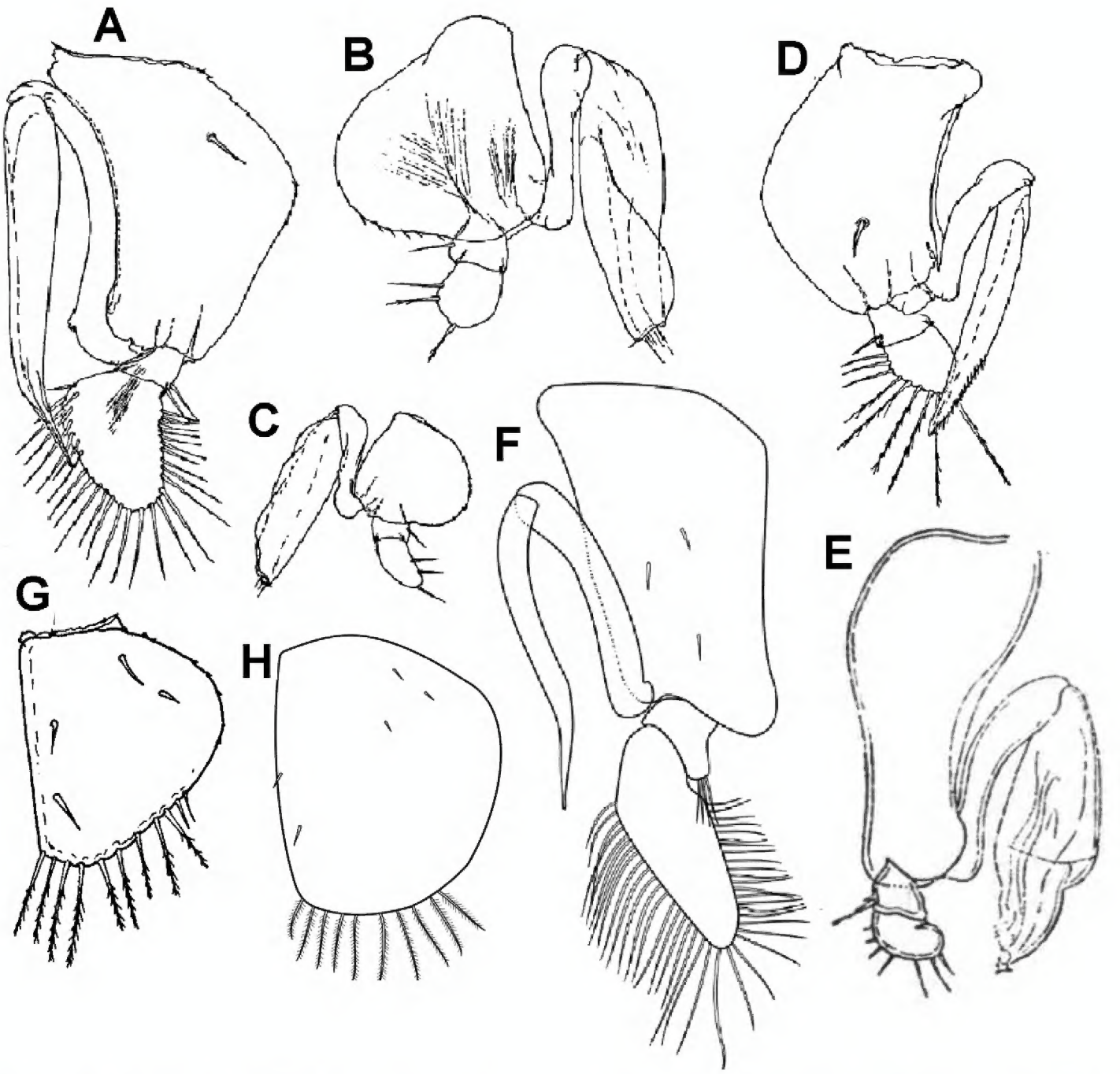


**Figure 6.** Male pleopod II of *Stenasellus vermeuleni* (**A**) *S. henryi* (**B**) *S. grafi* (**C**) *S. messanai* (**D**) *S. asiaticus* (**E**) and *S. tashanensis* sp. n. (**F**). (Figures **A–D** from Magniez and Stock 2000; Figure **E** from Birstein and Starostin 1949).

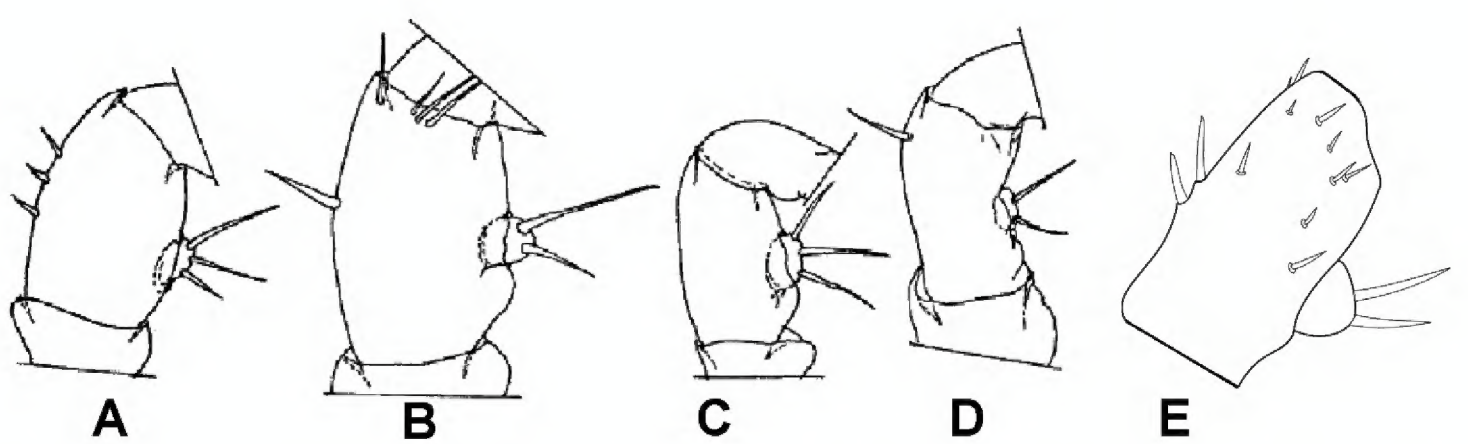


**Figure 7.** Squama of antenna II of *Stenasellus vermeuleni* (**A**) *S. messanai* (**B**) *S. henryi* (**C**) *S. grafi* (**D**) and *S. tashanensis* sp. n. (**E**). (Figures **A–D** from Magniez and Stock 2000).

(vs 12 in *S. vermeuleni*) and right mandible has 29–30 lifting spines (vs 13–14 in *S. vermeuleni*). Peraeopod I of *S. tashanensis* bears 19 strong denticulate setae on its propus (vs 11–13 in *S. vermeuleni*) and 19 strong setae on its dactylus (vs 12 in *S. vermeuleni*).

Probably molecular genetic analysis could lead to a better comprehension of the relationship of the various taxa present in the region. Several molecular studies exist on peri-Mediterranean and American stenasellids (Messana et al. 1995; Ketmaier et al. 1997, 2003; Baratti et al. 2003; Morvan et al. 2013). We know of no molecular studies of East African or Oriental stenasellids. Future studies will hopefully clarify the phylogenetic relationships within this group of these ancient stygobionts.

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